



The vanishing coast

In the wake of Hurricane Katrina, coastal experts are trying to gauge the destruction to Louisiana's marshes.

Emma Marris travels to the coast to learn what might be saved — and what might not.

Getting stuck was the highlight of the day. In Little Vermilion Bay, along Louisiana's fast-disappearing coast, researchers cherish every bit of land they can find. So when a boatload of scientists recently got stuck in chocolate-brown mud, they celebrated even as they struggled. "We got the boat through here last time," says Richard Raynie, a coastal-resources scientist at the Louisiana Department of Natural Resources (DNR), satisfied with the change.

The Louisiana coast, a lacy delta plain known for its seafood, oil, alligators and hurricanes, is unravelling. Generations of engineering projects, designed to make the soggy floodplain habitable, have disrupted the processes that held the wetlands together.

Water that once deposited sediments onto the Mississippi River Delta is now hustled into the Gulf of Mexico by levees and floodwalls. Canals let the sea into coastal marshes, bringing salinization and erosion.

Hurricanes Katrina and Rita, which hit opposite ends of Louisiana this August, underscored the marsh's fragility. The storms exposed the choices that must be made about land used for habitat, real estate, hunting, fishing, seafood and oil. Now, with the momentary but fading attention of the nation, scientists who have long worked to beat back the sea are being asked to solve every problem at once: Can we save everything? What do we

save first? What are the most effective methods? Where should the money come from?

The resources of the marsh, as well as the infrastructure located there, are worth a lot in Louisiana, and the state has long fought to keep its land from dropping into the sea. But in the 1990s, Louisiana lost just over 60 square kilometres of coastal wetland each year — an area the size of a football field every half-hour. Katrina and Rita washed away another 260 square kilometres, according to early estimates by the US Geological Survey (USGS).

New bayou

Engineers have built a series of projects to try to hold on to the land. Among them is the Caernarvon water diversion, 25 kilometres south of New Orleans, where river water pours through a levee onto wetlands.

It is a pale imitation of the flooding that once fed this area with sediment and freshwater. The diversion often flows at far less than its maximum capacity of 230 cubic metres per second — and since Katrina, it has not flowed at all because of a lack of electricity and other problems. Even under ideal conditions, estimates suggest, it will save only 65 square kilometres of land over 50 years.

Even so, there are signs that Caernarvon is bringing freshwater marsh back to the region. As researchers' airboats glide across the water, dozens of alligators wake up. Freshwater plants,

such as alligator weed and rattlebox, thrive. Roseate spoonbills mix with other birds.

But since Katrina blitzed through this area, open water and soggy land have swapped places. The wind picked up acres of marsh and flung it about in tiny handfuls called marsh-balls. Researchers are debating how many — if any — of these balls will take root in open water, perhaps creating new marshland.

The Caernarvon diversion opened in 1991, a year after Louisiana senator John Breaux got funding for coastal restoration. Now, a system of federal and state trust funds pays for such projects; even so, they restore only a small fraction of the lost wetlands.

The Breaux money funded a series of restoration projects without an overarching vision. "People began to ask: 'Do we have a big plan?'" says Gerald Duszynski, head of the DNR's office of coastal restoration and management. The result was a multi-agency plan called Coast 2050, stuffed with goals — protecting shoreline here, building a delta there, and diverting water all along the Mississippi.

Not surprisingly, the federal government balked at the \$14-billion price tag. A short-term, \$1.9-billion plan was drawn up. But the projects in that plan are not the integrated approach that the coast's problems demand, according to an evaluation released in November by the US National Research Council.

Meanwhile, some of the projects made

headway. In Little Vermilion Bay, near the Texas border, a \$900,000 project built 23 long, thin islands, known as terraces, to slow coastal erosion. Over the past few years, a whole cast of typical marsh plants has arrived, perhaps just in time: Hurricane Rita hit the area, but the terraces were thickly vegetated and so suffered only minimal erosion.

On a hot November day, DNR scientists David Castellanos and Dona Weifenbach work their way across the islands, recording every plant in metre-long segments. "*Alterniflora*, bull tongue, *Phragmites*, deer pea, alligator weed," Castellanos calls out. "We encourage everything that will hold its roots down," says Weifenbach.

The terraces work in many ways. "We protect the shorelines, but we also gain acreage," says Castellanos. By catching sediment, the terraces create additional land. A little less than half a metre was laid down between 1999 and 2003. Now — as Raynie and his colleagues discovered — there is enough to beach a boat.

Different strokes

Few dispute that Louisiana should fight to keep its land; hunters and fishermen value the marsh as much as the environmentalists. But there is disagreement over what kind of strategies should be used. Put simplistically, engineers prefer hard structures such as levees and rock walls, biologists prefer freshwater diversions such as Caernarvon, and geologists prefer soft earthworks such as terraces.

Each approach has its drawbacks. "For freshwater diversion really to work, it takes decades," says Shea Penland, a geologist at the University of New Orleans. Robert Twilley, a systems ecologist at Louisiana State University in Baton Rouge, agrees that diversions take time, but argues that they are worth doing because they run cheaply and improve the marsh. Expensive earth-moving exercises are "short-term triage," he says — something to keep the problem from getting worse.

One problem is where to get the earth from. "You can't just rearrange the resources — you need to bring in new resources," says Twilley. Some experts want to dredge up sediment from the sea floor and add it to the coast. In particular, a number of restoration experts have their eye on a huge vein of sand called Ship Shoal, 20 kilometres offshore.

These include Mark Kulp, also of the University of New Orleans, who is in a floatplane over Plaquemines Parish south of the city. As one goes south, the strips of land get narrower and the wreckage worse. Ten weeks after Katrina, an ocean barge lies on its side on a levee. Houses are a few heaps of lumber on a slab, and the ground twinkles with broken glass.

In Kulp's ideal world, this scenario would never happen again. The communities on the lower part of Plaquemines Parish would be moved to higher ground. "We need to be willing to cut our losses," he says. He calls this idea managed retreat, prioritizing which bits of



Swamped: scientists from Louisiana's Department of Natural Resources survey Little Vermilion Bay.

land are worth the money and energy to save. The National Research Council study noted that some people may have to leave vulnerable areas. The ideal time to move people, Kulp suggests, would be now, as so many were uprooted by this year's storms.

It's not clear whether the wetlands' sudden fame will improve the fortunes of the restorers. In June, Louisiana politicians scored nearly

\$90 million annually over four years for coastal restoration, in addition to the trust fund set up by the Breaux act. Legislators included \$1.4 billion for coastal restoration in an early version of a budget bill. It remains to be seen if it will be part of the final version, which lawmakers hope to get out before the end of the year.

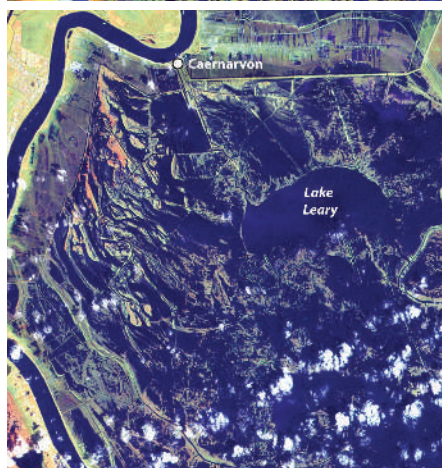
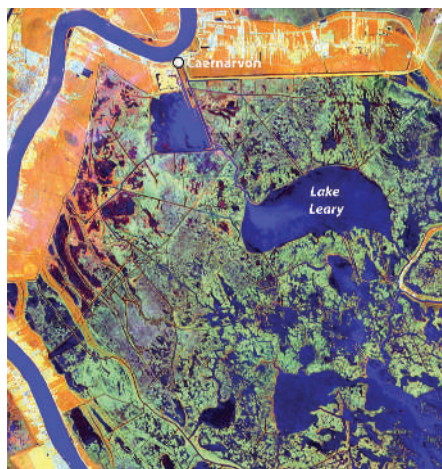
In rehab

Since Katrina, the state legislature has voted to combine hurricane protection and coastal restoration under one authority and, potentially, one trust fund. This makes Duszynski nervous. "We're worried that the pressure is going to be so heavy to build levees that the restoration will be left behind," he says. On the other hand, any windfalls for levee-building may possibly get redirected to restoration work. But money has to come soon, he warns. "The problem is that as time ticks on, the pressure is less to do anything," he says, "and then we are back to begging for restoration money."

At any rate, restoration is the wrong word for what these scientists are aiming for. None of them expect the levees and floodwalls to go. There is no one agreed map of what the coast should look like in the future. "You can restore, you can rehab, you can preserve," says Chuck Villarrubia of the DNR. "Really what you want to do is set the habitats on a trajectory that is sustainable."

Castellanos puts it another way: "The natural system has been altered, and you can't go back. The bottom line is that every time you increase that acreage, you get benefits — forage for fish, shoreline protection, and even aesthetic values for people." For every researcher who secretly wishes people would leave the marsh to the alligators, there is another who wants to use the tools of the restorer — rocks, sand, freshwater and mud — to engineer the coast they want. Coastal restoration, it is clear, is mostly coastal design.

Emma Marris reports for *Nature* from Washington DC.



Before and after: satellite images show marshland lost in Breton Sound, Louisiana, one of the areas hit hardest by Hurricane Katrina.

E. MARRIS

USGS NWRC